REMARKS

Claims 1-22 are all the claims presently pending in the application. This Amendment amends claims 1, 14, 18, 20, 22. No new matter is added to the amended claims. The claim are amended to merely clarify the subject matter of the claims and in not to narrow the scope of the claims in order to overcome the prior art or for any statutory purposes of patentability. Notwithstanding any claim amendments of the present Amendment or those amendments that may be made during prosecution, Applicant's intent is to encompass equivalents of all claim elements. Reconsideration in view of the foregoing amendments and the following remarks is respectfully solicited.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current Amendment. The attached pages are captioned "**VERSION WITH MARKINGS TO SHOW CHANGES MADE**."

Claims 1-22 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Sung (U.S. Pat. No. 6,184,945).

This rejection is respectfully traversed in view of the following discussion.

I. THE CLAIMED INVENTION

The claimed invention is directed to a liquid-crystal display device and method of forming the device. The inventive device includes a plurality of address wirings formed on an insulating substrate, a gate insulating film formed on the address wirings, a plurality of data wirings, the data wirings crossing the address wirings, an upper layer insulating film formed on the data wires, having thickness smaller than the gate insulating film, and a picture element area which includes a transparent electrode including transparent conductive film, formed on the upper layer insulating film and surrounded by the address wirings and the data wirings, a thin-film transistor section for selectively connecting the data wirings with the transparent electrode by a gate connected to the address wirings, and a capacitor section including a first electrode formed on the gate insulating film and including the same conductive film as in the data wirings, and a second electrode formed on the upper layer

insulating film and including the same transparent conductive film as in the transparent electrode, at least a portion of the upper layer insulating film being formed between the first electrode and the second electrode.

Conventional liquid crystal display devices form a capacitor section using an auxiliary capacitive common electrode, a gate insulating film, and a storage electrode. However, in this case the thickness of the dielectric layer and dielectric constant are limited, and an area of the electrode is increased if electrostatic capacity must be increased. As a result, the display is poorly lit and power consumption is increased.

The claimed device, on the other hand, includes a capacitor section including a first electrode formed on the gate insulating film and including the same conductive film as in the data wirings, and a second electrode formed on the upper layer insulating film and including the same transparent conductive film as in the transparent electrode, at least a portion of the upper layer insulating film being formed between the first electrode and the second electrode. Importantly, the upper layer insulating film has a thickness which is smaller than the thickness of the gate insulating film. As describe in the specification, a preferable mode of the invention is where ". . . the upper layer insulating film is thinner than that of the gate insulating film or a dielectric constant of the upper layer insulating film is larger than that of the gate insulating film. This allows the capacitor section having larger electrostatic capacitance per area compared with the case of the conventional liquid-crystal device using the gate insulating film as a dielectric layer in the capacitor section. If the value of capacitance is the same, the aperture ratio can be improved."
(Application, p. 12, lines 11-19)

II. THE SUNG REFERENCE

The Examiner alleges that Sung teaches the claimed invention. Applicant submits, however, that there are elements of the claimed invention which are neither taught nor suggested by Sung.

Sung discloses a liquid crystal display apparatus that includes electrodes which are faced with pixel electrodes and which allegedly generate cumulative capacity. Gate

electrodes and the substrate are covered with a first (gate) insulating film. Over the first insulating film is a semiconductor active film. A second insulating film corresponds to a pixel part and is provided to cover the thin film transistors, the first insulating film, and source wires. Sung further discloses a film insulating layer that is sandwiched between a first electrode film and a pixel electrode to form cumulative capacity that cancels out part of the parasitic capacity created in the liquid crystal display apparatus (Sung, col. 9, lines 43-55). The cumulative capacity thus allegedly generated cancels out part of the parasitic capacity created in the liquid crystal display apparatus (Sung, col. 9, lines 52-54).

However, the foregoing disclosure in Sung is found in Sung's own cited prior art. Referring to Sung Figures 10 and 11, auxiliary electrodes 12 are installed opposite to pixel electrodes 11. "Each pixel electrode 11 and its corresponding auxiliary electrode 12 sandwich the passivation film 10 to constitute a capacitor providing a cumulative capacity that is used to inhibit the adverse effects of a parasitic capacity generated naturally upon liquid crystal activation." (Sung, col.1 lines 55-67). Thus, the change by Sung over his own prior art is moving an electrode (12) above a gate insulating film (3) yet remaining below a passive insulating film (10) (compare Figure 10 "PRIOR ART" with Figure 5: electrode 103 in Figure 5 is formed above gate insulating film 92 yet below passive insulating film 100).

Applicant's invention teaches an improvement of capacitance of a pixel part in an LCD display over the prior art, including Sung, that was discovered by changing not only the location of the first electrode but also in changing the properties of the insulating layer between the first electrode and the pixel/transparent electrode layer. According to the conventional method, a dielectric layer between the address wiring and the transparent electrode is relatively thick and electrostatic capacitance per area is small, accordingly. (Application, p. 4, lines 15-20). Increasing the capacitance area causes numerous problems, including the reliability of the LCD device itself and difficulty in manufacturing processes. (Application, p. 5, 18-30; p. 6).

The present invention teaches that since a capacitor is formed through the upper layer insulating film between the first electrode and the second (pixel/transparent) electrode, a thickness of material for the upper layer insulating film can be selected independently of the gate insulating film. Furthermore, by adjusting the thickness or a dielectric constant of the

upper insulating film, the capacitor can be formed with a desired electrostatic capacitance without extension of the area (Application, p. 9, lines 10-20).

Sung does not disclose the effects of thickness or property variations of the two insulating layers will have on capacitance, as cited in claim 1. Sung does not teach or suggest "an upper layer insulating film formed on said data wires, wherein said upper layer insulating film is formed in a thinner layer than the gate insulating film. . . " as recited in revised claim 1 and in method claims 14, 28, 20, and 22. This embodiment is described in the specification, stating

> [a] preferable mode is one wherein the upper layer insulating film is thinner than that of the gate insulating film or a dielectric constant of the upper layer insulating film is larger than that of the gate insulating film. This allows the capacitor section having larger electrostatic capacitance per area compared with the case of the conventional liquid-crystal device using the gate insulating film as a dielectric layer in the capacitor section. If the value of capacitance is the same, the aperture ratio can be improved. (Application, p. 12, lines 11-19)

Referring to Figure 2, the Application specifically describes advantages to controlling the thickness of the upper insulating film and the thickness of the gate insulating film. The specification states that

> "[i]n the capacitor section 105, since the dielectric layer (the upper layer insulating film 8) between electrodes is composed of the silicon nitride film having its film thickness being smaller than that of the gate insulating film 5 and having a high dielectric constant, electrostatic capacitance per area is made larger when compared with that in the conventional liquid-crystal display device employing the gate insulating film 5 as the dielectric layer." (Application, p. 24, lines 18-25)

For example, in an embodiment of the present invention, the gate insulating layer is

specified as composed of a silicon oxide film that is 1500 angstroms thick and a silicon nitride film 3250 angstroms thick, for a total of a gate insulating layer of 4,750 angstroms thick (Application, p. 25, lines 15-20). Additionally, the upper insulating layer is specified as composed of a silicon nitride film 1500 angstroms thick, or less than a third of the thickness than the thickness of the gate insulating layer (Application, p. 26, lines 12-15).

Clearly, Sung does not teach these novel features. Sung's prior art Figure 10 illustrates the gate insulating layer 3 as a layer that appears to be approximately three times the thickness of the passive film layer 10. Note also that the novel features of the present invention are not shown in Figure 5 of Sung.

Moreover, Sung does not even recognize the problems which the claimed invention addresses. Sung merely moved the electrode 12/103 above the gate insulating layer 3/92 (see Sung, Figures 5 and 10). However, Sung did not teach nor disclose the advantages to controlling both the thickness and properties a first gate insulating layer and the thickness and properties of a second upper insulating layer, as is taught in presently pending claim 1, which states: "said upper layer insulating film having a smaller thickness than the gate insulating film. . . ."

For at least the reasons outlines above, Applicant respectfully submits that Sung fails to teach or suggest each and every feature of claims 1, 14, 18, 20, 22. Accordingly, Sung fails to anticipate the subject matter of claim claims 2-13, and 21 depending from claim 1; and claims 15-17, and 19 depending from claim14. Therefore, the Examiner is respectfully requested to withdraw this rejection.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1-22, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed

below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE IN THE CLAIMS:

The claims were amended as follows:

1. (Twice Amended) A liquid-crystal display device comprising:

a plurality of address wires formed on an insulating substrate;

a gate insulating film formed on said address wires;

a plurality of data wires, said data wires crossing said address wires;

an upper layer insulating film [grown] formed on said data wires, said upper layer insulating film having a smaller thickness than the gate insulating film; and

a picture element area comprising:

a transparent electrode, comprising a transparent conductive film, formed on said upper layer insulating film and surrounded by said address wires and said data wires;

a thin-film transistor section for selectively connecting said data wires with said transparent electrode by a gate connected to said address wires; and

a capacitor section comprising:

a first electrode formed on said gate insulating film and comprising the same conductive film as in said data wires[,] ;

a second electrode on said upper layer insulating film and comprising the same transparent conductive film as in said transparent electrode[,] ; and

at least a portion of said upper layer insulating film [being] formed between said first electrode and said second electrode.

14. (Twice Amended) A method for producing the liquid-crystal display device of claim 1, comprising:

forming a plurality of address wires on an insulating substrate;

forming a gate insulating film on said address wires;

forming a plurality of data wiring on said gate insulating film, so that said data wires and said address wires cross each other;

forming a thin-film transistor for selectively connecting said data wires with said transparent electrode disposed in each picture element area by a gate connected to said address wires, in each picture element area surrounded by said address wires and data wires;

forming a first electrode using the same conductive film as used to form said data wires;

forming an upper layer insulating film on said first electrode, said upper layer insulating film having a smaller thickness than the gate insulating film;

forming a second electrode using the same transparent conductive film as used to form said transparent electrode; and

forming said capacitor section using said first electrode, said second electrode, and said upper layer insulating film.

18. (Twice Amended) A method for producing the liquid-crystal display device of claim 11, comprising:

forming a plurality of address wires on an insulating substrate;

forming a plurality of auxiliary capacitive common wiring parallel with said address wires;

forming a gate insulating film on said auxiliary capacitive common wiring;

forming a plurality of data wires on said gate insulating film, so that said address wires and data wires cross each other;

forming a thin-film transistor for selectively connecting said data wires with said transparent electrode in each picture element area by a gate connected to said address wires, in each picture element area surrounded by said address wires and data wires;

forming said first electrode using the same conductive film as used to form said data wires;

forming said upper insulating film on said first electrode, said upper layer insulating film having a smaller thickness than the gate insulating film;

forming said second electrode using the same transparent conductive film as used to form said transparent electrode; and

forming said capacitor section using said first electrode, said second electrode and

said upper layer insulating film so that said capacitor is one of partially and totally superimposed on said auxiliary capacitive common wiring.

20. (Twice Amended) A method for producing the liquid-crystal display device of claim 4, comprising:

forming a plurality of address wires on an insulating substrate;

forming a gate insulating film on said address wires;

forming, in said gate insulating film, a through hole which extends to said address wires;

forming a plurality of data wires on said gate insulating film so that said address wires and data wires cross each other;

forming a thin-film transistor for selectively connecting said data wires with said transparent electrode in each picture element area by a gate connected to said address wires, in each picture element area surrounded by said address wires and data wires;

forming said first electrode using the same conductive film used to form said data wires;

connecting said first electrode to said address wires via said through hole formed in said gate insulating film;

forming said upper layer insulating film on said first electrode <u>said upper layer insulating film having a smaller thickness than the gate insulating film</u>;

forming said second electrode using the same transparent conductive film used to form said transparent electrode; and

forming said capacitor section using said first electrode, said second electrode and said upper layer insulating film.

22. (Amended) A method of fabricating a liquid-crystal display device, said method comprising:

forming a plurality of address wires on an insulating substrate;

forming a gate insulating film on said address wires;

forming a plurality of data wires on said gate insulating film, so that said data wires

and said address wires cross each other;

forming a thin-film transistor for selectively connecting said data wires with a transparent electrode by a gate connected to said address wires, said transparent electrode being located in a picture element area surrounded by said address wires and data wires;

forming a first electrode using the same conductive film as used to form said data wires;

forming an upper layer insulating film on said first electrode, said upper layer insulating film having a smaller thickness than the gate insulating film;

forming a second electrode using the same transparent conductive film as used to form said transparent electrode; and

forming a capacitor section using said first electrode, said second electrode, and said upper layer insulating film.